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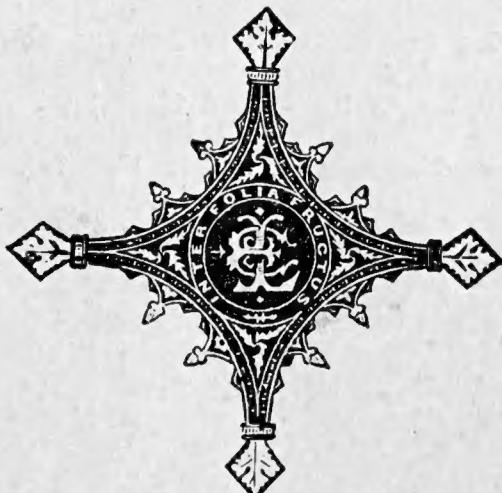
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TO MAN.**

By A. S. PACKARD, JR.,

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3. Relations of Insects to Man.

IN continuing these half-hour talks about insects, some remarks upon the more direct relations of these little beings to human interests may not be inappropriate. We may, from our moral and intellectual heights, look down upon the lower world of insects as did the gods and demi-gods of old from Olympus upon their half-brothers and cousins-german on the plains below. For physically are we not related to the insects? Remotely, it is true, but still we have perhaps branched off from a common stock, the starting point some monad. Our blood differs in quality and not in kind; our muscles are but repetitions in structure of the flesh of insects; and finally, an insect at the outset is but a drop of oil and albumen or protoplasm, and from what else does man originate? Allied as he is also to the beasts and lower animals in being at times under the control of fierce passions and animal propensities, while morally and intellectually the noblest work of the Creator, one effect of the recent advances in the science of man, which indicate that his animal origin is a matter of strong probability, will be to draw out his interest in the humbler creatures, to lead him to deal with them more sympathetically, to love his domesticated animals more wisely and truly; while he may not the less, by worship of his Creator and work for humanity, strengthen the diviner impulses of his nature.

“He prayeth well, who loveth well
Both man and bird and beast.”

Every true naturalist is an *ex-officio* member of the “Society for the Prevention of Cruelty to Animals.” He will not beat his horse or dog any more than his own children. Rather

will he endeavor to train them by the power of kindness than by the force of blows.

So in the dealings of civilized with savage man ; the legitimate results of a proper study of anthropology, or the science of man, while teaching us that there are different grades of intellect and moral sense in the different races of man, as in the members of our own families, where each may require a different mode of education though all are equally loved by their parents, will lead us to observe the primary law of international behavior—the law of love. Each may require a different mode of treatment, while all must be regarded as men and brothers.

Though one race under a favoring heaven and superior mental organization stands superior to another, yet, if many naturalists are right, all have had a common monkey origin ; and the European or American of to-day need not despise his Bushman or Australian brother, who is perhaps but a few removes nearer his simian ancestors than himself.

So all the animal creation is of a piece ; part and parcel of one grand Divine plan. Some philosophers and theologians even ascribe immortality to the animals, and believe that in the hereafter we shall hear the song of the mosquito, the hum of the bee, and the shrill rolling drum-beat of the cicada.

Insects are related to us in a thousand ways, and somehow, either by themselves or through their products, they are, more than we should at first imagine, constantly in our daily thoughts. Beau Brummel's cravat, which historians tell us absorbed no small proportion of his thoughts in his waking moments, was spun by a silkworm. A spider's web, tradition says, saved King Robert Bruce in his sleep. Thousands of people in the East are dependent for life on locusts and wild honey. Is the potato beetle an unimportant personage in the west? And in the south are not hundreds of thousands of dollars' worth of cotton annually devoured by

the army worm? In the New England states is not the face of nature almost transformed by the ravages of the canker worm? How life to many would be glorified, and this world seem a brighter one, if the flea, the louse and the bed-bug were removed from its surface!

How much difference would it make to the world of insects were man to be blotted out of existence? We imagine the insects would look with as much indifference upon his removal as we in turn regard the demise of a mosquito. Have not, through the ages past, from the time when the first grasshopper chirped upon a tree fern's leaf in the Devonian forests of New Brunswick, millions of species of insects had their day and died, with no human being to witness them? Imagine the eons and eons of measured eternity through which by day and night the busy hum of insect life has risen and fallen with no human ear to listen. But on the other hand blot out those busy servants of ours, the bees; the myriads of insects that aid in fertilizing our vegetables and fruit trees; the silkworm, whose products form so large an item in the commercial greatness of the East and of Southern Europe; the lac and dye insects; those that produce galls for making ink; the myriads of grubs and flies that act as scavengers, and purify the air, saving us from pestilence; all working so quietly and effectively that few appreciate how much we owe to them—blot out all of these and the world would be a poor home for its owner, man. He would be forced then, if never before, to appreciate the place of man in creation, and would be taught that as an animal his life touches at many points the lives and interests of the humble creatures about him.

We naturally divide insects into friends and foes, but our senses are still quite uninstructed in distinguishing them, and few but the trained entomologist can go into the field or garden and mark this insect as a true friend, and that, so much like the other that ordinary eyes cannot

distinguish them apart, as an enemy of our comfort or crops.

Moreover there are insects which are friendly in but a Pickwickian sense. There are certain parasitic insects that stick to us closer than a brother, and yet with the moral qualities of fiends. Man is a sort of treasury or bank to these creatures — and they are happily few in number — who “draw” upon him not only “at sight,” but who “go it blind.” And when through carelessness or idleness the bank is too attractive and liberal in its discounts, the audacious vermin congregate in teeming hosts, and make “a run” upon it. Parasitic insects seem in many cases to be actually blind through ava-

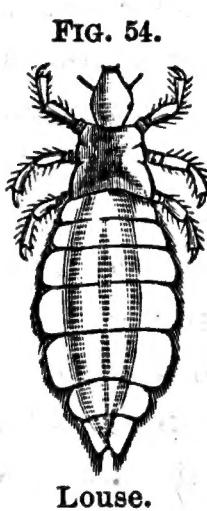


FIG. 54.

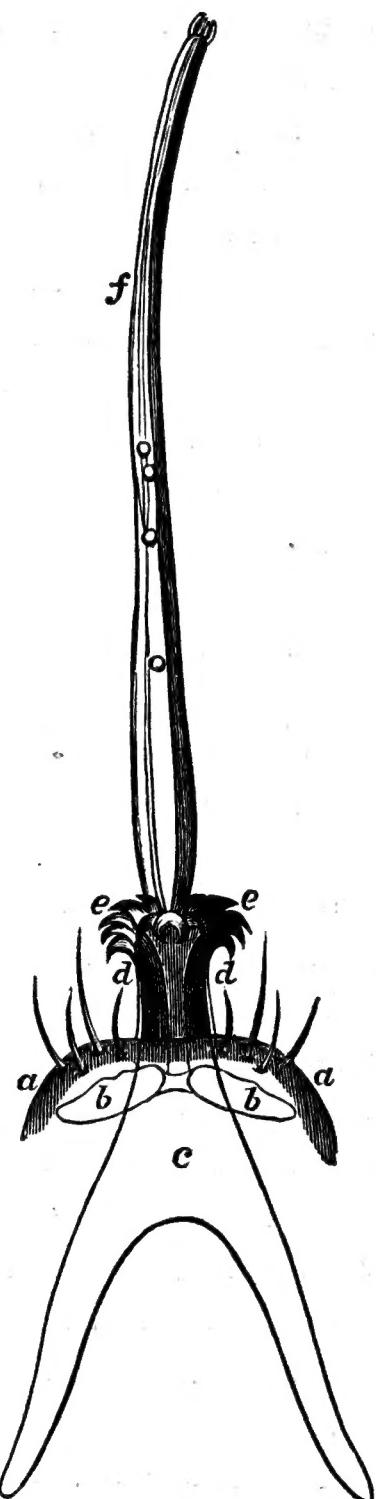
rice, as amaurosis is not an uncommon affection among articulated parasites. It would seem as if the gods struck blind all such beings for their greed in sucking our blood.

There is the louse (Fig. 54), the most intimate of these friends, forsooth, of ours. Ugly and repulsive in itself, it is tenfold more so in its associations. Though its legs are well developed, the beak wonderfully adapted for its use, yet it lives in a Stygian twilight, its eyes reduced to a simple point, a little depression on the side of its head forming but a single isolated facet, the simplest kind of eye, when there are 25,088 such facets in the eye of a certain small beetle (*Mordella*) and 4000 in that of the house fly, whose head is all eyes. If we look at the beak of the louse (Fig. 55) we shall at once perceive that the creature does not bite, but that it in reality sucks our blood; so the mosquito introduces its blade-like jaws and sucks our blood. It is incorrect to say that a mosquito bites. Those organs that in allied insects are jaws, in the lice lose their biting function and are converted into a fleshy extensible tube, the true jaws forming ribbon-like bands strengthening the tube.

When looking about for a weak place in the skin of his host the creature alights upon a sweat pore. Into this he plunges his sucker, and anchors it there by a number of hooks (Fig. 55, *ee*). After they have firmly grasped the surrounding flesh the first pair of bristles (the real mandibles transformed) are protruded (we are quoting Prof. Schiödte here almost word for word, as given in the "American Naturalist," vol. iv, p. 86). These bristles are towards their points united by a membrane so as to form a closed tube. When the whole instrument is exserted, we perceive a long, membranous, flexible tube (the portion from *e-f* and including the end) hanging down from the under lip (labium), and along the walls of this tube the bristle-like jaws in the form of narrow bands of chitine.

In this way, says Schiödte, the sucking tube can be made longer or shorter as required, and easily adjusted to the thickness of the skin in the particular place where the animal is sucking, whereby access to the capillary system is secured at any part of the body. "It is apparent from the whole structure of the instrument, that it is by no means calculated for being used as a sting, but is rather to be compared to a delicate elastic probe, in the use of which the terminal lobes probably serve as feelers. As soon as the capillary system is reached, the blood will at once ascend into the narrow tube, after

FIG. 55.



Mouth of a Louse.

which the current is continued with increasing rapidity by means of the pulsation of the pumping ventricle and the powerful peristaltic movement of the digestive tube." Fig. 55 shows this tube and adjacent parts of the head magnified one hundred and sixty times ; *aa* the end of the head ; *bb* the chitinous band, and *c* the base of the under lip ; *d* the under lip protruded, with the hooks *ee* ; and *f* the sucking tube, with a few blood disks passing through it.

How a louse breathes is perhaps as practical a question as how it bites. All insects inhale air through a row of holes (stigmata) in the side of the body, which connect by a series of tubes (tracheæ) within, ramifying throughout the body ; no air is taken in through the mouth. Now grease and oil, when in contact with the sides of the body, tend to close up these breathing holes, and then the creature suffocates. Thus oil or pomatum is an antidote. A word to the wise is sufficient.

Not only personally, but also indirectly, through those kinds which swarm on his domestic fowls and quadrupeds, is man affected by these creatures. Those species which live for the most part on birds have true jaws, enabling them to nibble and thus irritate the skin of their host.

While we are upon this harassing theme we should not pass over that kindred subject the bed-bug. This insect, with a body so flat that an ordinary punch with the thumb only seems to tickle it, seems preordained for a life in cracks and crannies. First noticed in literature by Aristotle, it was also mentioned by Dioscorides and Pliny. It was first met with in Germany in the eleventh or twelfth century, and was mentioned as an English insect by Mouffet in 1503. It is possible that its original haunt was the nests of doves and swallows ; and the most effective way, should it seem desirable to ensure an abundant harvest of these pests, is to keep a number of these birds about our houses. Whether it actually lives under the feathers of doves or not could be

easily ascertained. If so, then they are as truly bird parasites as the lice, to which they are (especially when young) not remotely allied in form and structure. That they (or a closely allied species) sometimes swarm in the nests of swallows, we have been informed by a gentleman in Iowa, who found a nest of swallows, as stated in the "Guide to the Study of Insects," on the outside of a court house which swarmed with bed-bugs; and they were not confined to the nest, but flocked in the apartments, "frequently serving well pointed bills of ejectment against the legal gentlemen within." They continued to trouble the occupants year after year until the stream of hemipterous life was traced to its fountain head, the swallows' nests. The opinion that the bed-bug originally lived under the feathers of house-haunting semi-domestic birds is strengthened by the fact that a European species of *Cimex* lives on the body of the swallow, another on the bat, while a third is found in pigeon houses and is named from that fact the *Cimex* of dove-cotes (*Cimex columbarius*). We have in this country a flat bodied red bug, closely allied to the true bed-bug, but its habits are quite unknown.

We need not tell harrowing tales of the disgusting habits of this scourge, for are there not fresh experiences in the minds of those who travel most in the more unsettled portions of our country, as well as the other parts of the globe? A word or two on some less known traits of this creature may give some useful hints in dealing with it. The parent lays white oval eggs, and when the young bug is fully formed within it escapes by pushing off the end like a lid, as one pushes up a trap door. The young are at first whitish and transparent, the stomach being visible, usually red from being filled with blood, and at this time it bears a striking resemblance to a louse. Westwood says that it is eleven weeks in attaining its full size. The adult is hard lived in a double sense; its tenacity of life is only equalled by its viciousness

The Swedish Count Degeer, in his classic *Mémoires*, published a century ago, says that he kept full sized individuals in a sealed bottle for more than a year without food. Dr. Landois has recently ascertained how these insects are enabled to fast so long. He observed that, as in the flea and louse, the blood drawn in from their victims, collecting in the small intestine, loses its cells and forms a blackish mass, which remains for months unaltered. "Thus after the bug has fully gorged itself, it has within its small intestine a reservoir on which it may live a long time."

But happily, though few may be aware of it, the bed-bug has a natural enemy, the cockroach, whose "mission" it

FIG. 56.

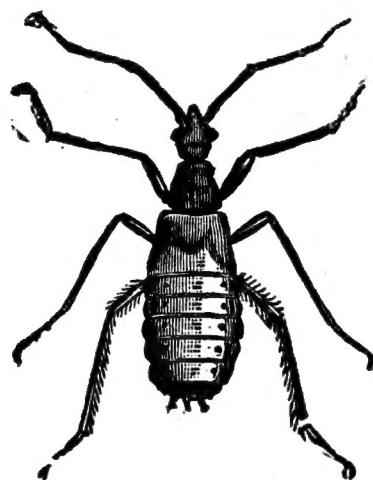


FIG. 57.



Reduvius, pupa and young.

seems to be to keep this and other insects in check. What, then, if the cockroach nibbles our towels and clothes occasionally when driven through stress of hunger? The cockroach is particularly valuable on ship-board by reason of its insectivorous habits. The Reduvius (Fig. 56, pupa) is also said to prey upon the bed-bug. Degeer tells us that the wingless young (Fig. 57) have the instinct to envelop themselves in a thick coating of particles of dust, and "so completely," adds Westwood, "do they exercise this habit that a specimen shut up by M. Brullé, and which had undergone one of its moultings during its imprisonment,

divested its old skin of its coat of dust, in order to recover itself therewith."

Does the bed-bug poison us when it bites? So we may ask whether the flea, mosquito and black fly, convey a drop of poison into the punctured wound they make. This is a disputed point. Dr. Landois, however, the latest writer on this subject, thinks that "when the creature is sucking, a part of the salivary fluid can easily pass into the wound, and it is not unlikely that the red stains that we often see appearing after a sting on the hands of sensitive persons originate from the saliva which flows into the wound and acts as a poison." Other hemipterous insects, he adds, are dreaded on account of their sting. "*Cimex nemorum*, according to Kirby, stings as powerfully as a wasp, and *Notonecta glauca* stings with a burning sensation." St. Pierre found in the Mauritius bugs whose sting was as poisonous as that of a scorpion, giving rise to swellings the size of a dove's egg and which lasted for five days.

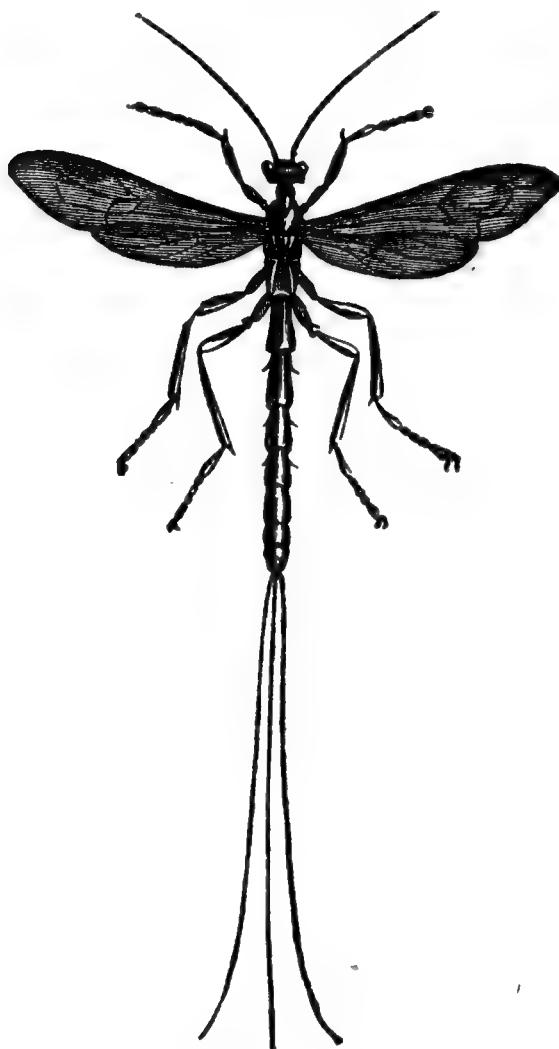
Another sort of bug is sometimes, according to Mr. Riley, found in beds in the western states. It is the *Conorhinus sanguisuga*. It is much larger than the common bed-bug, and its bite is much more painful. It belongs to quite a different group of hemipterous insects and is allied to the *Reduvius* of which we have spoken.

Passing by the flea and the itch mites, which end the list of human parasites, and whose habits and appearance are so well known, we will dwell for a few moments on the poisonous insects which trouble man. The poison of all insects, judging from the chemical composition of that of a few kinds which has been analyzed, is alkaline in its nature, and has for its main ingredient formic acid, a substance peculiar to the secretions of insects.

The sting of the bee is simply a modified form of the ovipositor of the ichneumon fly (Fig. 58, from Figuier) and the saw of the saw fly. It is composed of three pairs of

slender blades; the innermost, forming the sting proper, being barbed at the end so that when darted into the flesh of its victim it often remains and the bee stings but once. The poison gland or bag empties into the sting, the poisonous fluid being forced by the pressure of the walls of the body upon the sac, there being apparently no special muscles

FIG. 58.



Ichneumon Fly.

adapted for the purpose. The sting of the wasp is like that of the bee. The celebrated Réaumur, as quoted by M. Tandon, thus discourses on the effect of the sting of wasps on himself and his servant: "Being stung by a wasp, I thought I might gain something from his infliction by bearing it with a good grace. I allowed the animal to wound

me at his leisure ; when he had withdrawn his sting of his own accord I irritated and placed him on the hand of a domestic, who was not expecting to be stung, but the wound did not cause him much pain. I then made the wasp sting me a second time, when I scarcely felt it. The poisonous fluid was nearly exhausted by the former experiments, and I could not induce the wasp to make a fourth wound. This experiment and others, which people will probably not care to repeat, have taught me that where the animals are undisturbed the sting is never left in the wound. The sting is flexible, and is not driven straight in, but forms a curved or zigzag wound. If the insect is compelled to withdraw it suddenly, the friction is sufficient to retain the sting, which is somewhat hooked, and tears it off. On the other hand, if the animal is not disturbed, it withdraws the sting gradually."

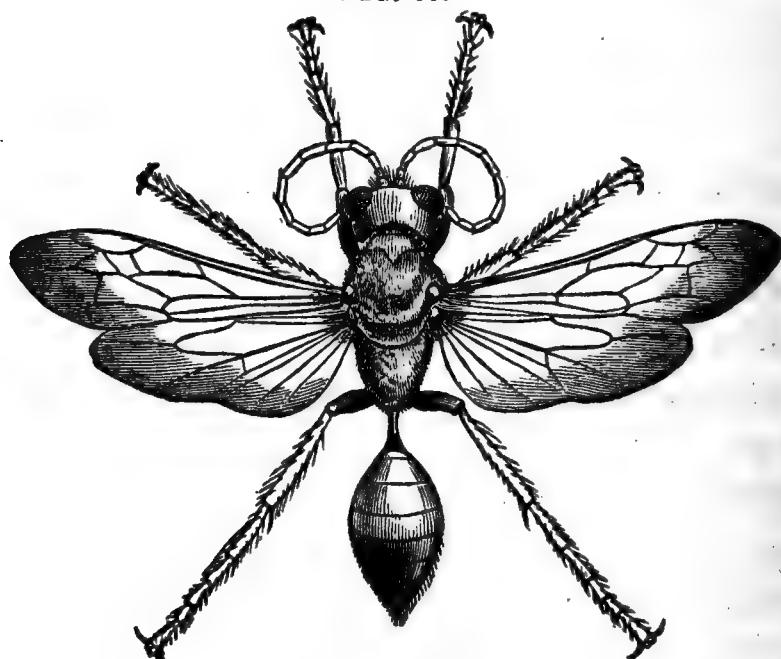
There is quite a difference in the poisonous qualities of different kinds of bees as well as wasps, and in the size and strength of the sting. We have been used to catching wild bees and wasps, without being stung, by firmly grasping the hind body or abdomen with our fingers, rendering the sting powerless.

How useful the sting is to bees is shown in the honey bee, which uses it as a weapon of offence as well as defence, in stinging the caterpillars of the bee moth, which are careful to run concealed galleries in the wax to avoid their thrusts ; and in killing the drones.

The term waspish is derived from the irritable nature of those insects, whose brusque and defiant manners are doubtless in large part due to the consciousness that they are well armed. But in many wasps the sting is not only a weapon of defence, but of prime importance in maintaining the existence of their young and consequently of the life of the species. We have spent hours watching a *Sphex* wasp (*Sphex ichneumonea*, Fig. 59), a large rust-red species

covered with dense golden hairs, busily engaged in digging its hole in a gravelly walk. Away it worked in a lusty, hearty manner, literally tooth and nail, removing the larger bits of gravel with its large curved sickle-like jaws; and as it finally tunnelled itself out of sight, it would often back up out of its hole, and scratch and shovel the dirt out with its fore and hind legs, pushing back the dirt from the mouth of its hole with its long hairy hind legs. As soon as its hole was a few inches deep, perhaps four or five, it flew off to the grassy bank close by and immediately returned with a green

FIG. 59.



Sphecodes Wasp.

grasshopper which it had evidently stung and paralyzed, as it did not kick and struggle. It disappeared for a few minutes in its hole, long enough apparently to lay an egg in the body of the grasshopper, which was destined only to awake from its death-like lethargy to find itself the prey of the young Sphecodes.

That the sting of the wasp is so wonderfully guided as to pierce one of the nervous centres (ganglia) of the grasshopper, so that the insect is paralyzed, is proved by the observations of a French naturalist, Fabre, who has given us

a charmingly written account of his experiences with a wasp called Cerceris, which had been known to sting, and consequently paralyze, its prey, consisting of the larva or grub of a certain weevil. M. Fabre waylaid a Cerceris returning with her booty, and substituted a fresh, uninjured weevil grub for the one paralyzed. "This experiment succeeded to admiration. As soon as the Cerceris perceived her prey to have slipped from her grasp, she struck the earth with her feet, and turned impatiently hither and thither: then, suddenly perceiving the living curculio, placed close to her by M. Fabre, pounced upon it, and proceeded to carry it off. Instantly, however, discovering it to be still uninjured, she placed herself face to face with it, seized its rostrum between her powerful mandibles, and pressed her fore legs heavily upon its back, as if to cause the opening of some ventral articulation. Quickly then she slid her abdomen beneath the curculio, and struck her venomous dart sharply twice or thrice into the joint of the prothorax, between the first and second pair of legs. In one second, without a convulsive movement, without those twitches of the limbs which generally accompany the death agony of any animal, the victim dropped motionless, struck as if by lightning. The Cerceris then, turning the apparently lifeless insect on its back, embraced it as before described, and bore it away in triumph. Three times did M. Fabre repeat this interesting experiment, each time with precisely similar results. It must be clearly understood that on each occasion he restored to the Cerceris her original captive, and took possession of that which he had himself provided, in order to examine it at his leisure. Greatly did he marvel at the dexterity with which the fatal stroke had been dealt. Not the slightest trace of a wound was to be found; not the least drop of vital liquid spilt. The puncture made by the sting of the Cerceris is indeed so microscopic that chemistry can furnish no poison sufficiently powerful to produce with so

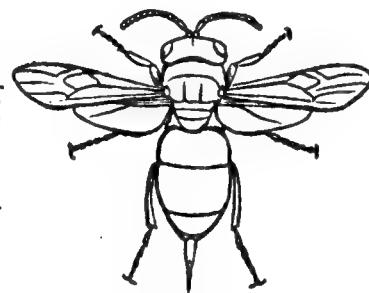
small a quantity so startling an effect; and it is, in fact, not so much to the venom of the dart as to the physiological importance of the exact point at which it enters, that we must ascribe the cessation, so complete, so instantaneous, of all active life.

"In most insects there are three ganglia, which furnish the nerves of the wings and legs, and on which the power of movement principally depends. The first, that of the prothorax, is distinct from the others in all Coleoptera; but the last two, those of the meso- and meta-thorax, though generally separate, are in some species united. Now it is a well-known fact that, in most cases, the more closely the nervous system is united, *centralized* as it were, the more perfect are the animal functions, and also, of course, the more easily vulnerable. Therefore the Cerceris, whose instinct teaches her at one stroke to annihilate these functions, chooses her victims precisely from the species in which this centralization is most complete.

"In order completely to establish his opinion, it remained for M. Fabre to prove that he could by similar means produce a similar result. And this he found himself able to perform with perfect ease, by puncturing the insect with a needle dipped in ammonia at the prothoracic joint, behind the first pair of legs. Any corrosive liquid applied to the thoracic medullary centre would have the same effect." His experiments were made upon the grubs of various beetles. "In the case of Scarabæi, Buprestes and Curculionidæ, the effect of his experiments was instantaneous; all motion ceased suddenly, without a single convulsion, at the instant the fatal drop touched the medullary centre. Not the dart of the Cerceris herself could have a more prompt or lasting effect. Notwithstanding their complete immobility M. Fabre's victims remained alive for three weeks or a month, preserving the flexibility of all their joints, and the normal freshness of their viscera."

My own observations on another wasp (*Odynerus albophalearatus*), which makes its round cells of clay, placing them for safety in the loose nest of the American Tent Caterpillar, have shown me that Fabre's account must be correct. On opening these cells, they were found to be filled with minute caterpillars, which were in various stages of growth between the fully formed caterpillar and the chrysalis. They were alive, but benumbed, and in some cases with life enough to finish their transformations into the chrysalis state. Here they were waiting patiently each for his turn to be devoured by the young wasp. What a marvellous instinct on the part of the wasp, and how much more wonderful when we remember that this is a habit of but certain groups of wasps, and that it must have been acquired by them from some ancestor which had to find out for itself the secret of stinging its victim so as to simply paralyze and not kill outright the luckless subject of the experiment. Again, was the discovery made by accident, or did our ancestral wasp go about it

FIG. 60.



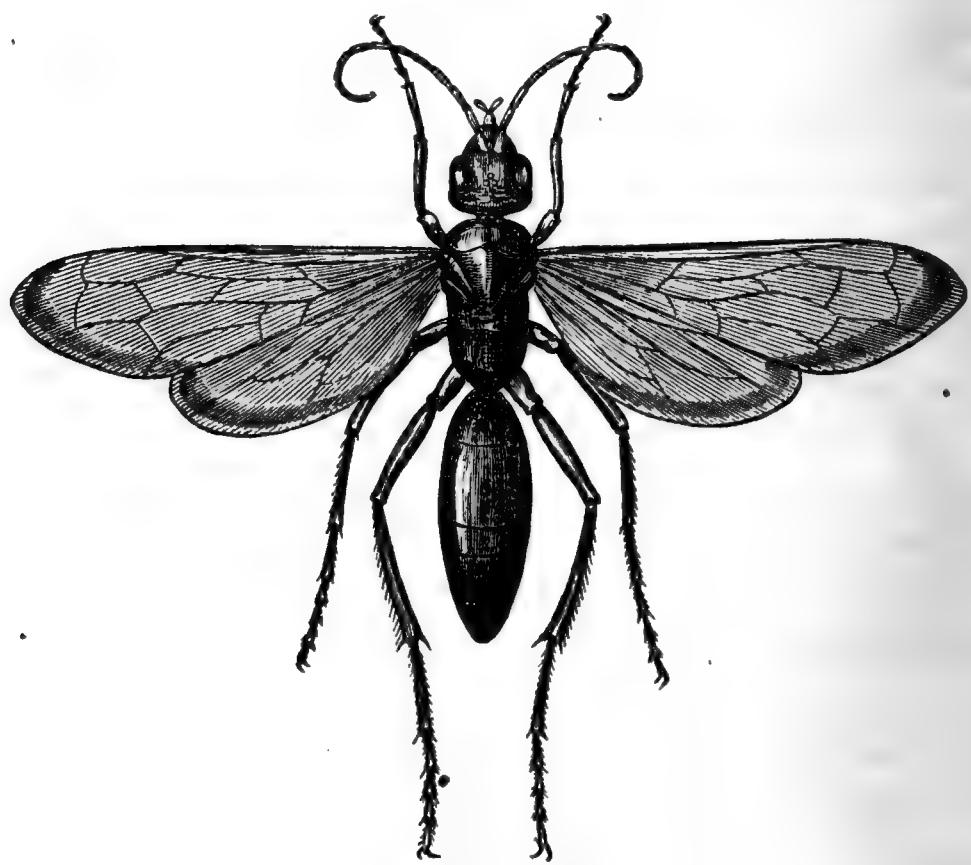
Chrysis.

like a philosopher, and after conducting a series of experiments, guided by the "scientific use of the imagination" alight finally upon just the weak spot in its victim's harness in which to insert its sting? This thought may be considered as twaddle by some, but in all seriousness we would say that nature must have had that insect in training. Any one who has observed a wasp building its nest, or a Chrysis wasp (Fig. 60) exploring the nail holes in a post with its inquisitive sting, combining the terrible qualities of a poisoned dagger with the delicate touch of a finger, and then imagines the series of deductions following each trial of the sting, the momentous result attending the exploitation to the future weal of the Chrysis family, and the ultimate good to the species — how can he say that there we

have not a reasoning being under the tuition of nature's laws?

In like manner the Tarantula Killer (*Pompilus formosus*, Fig. 61), according to an exceedingly interesting account published by Dr. Lincecum in the "American Naturalist" (May, 1867), attacks that immense spider, the *Mygale Hentzii* (Fig. 61), paralyzes it with its formidable sting, and, inserting an egg in its body, places it in its nest, dug to the

FIG. 61.



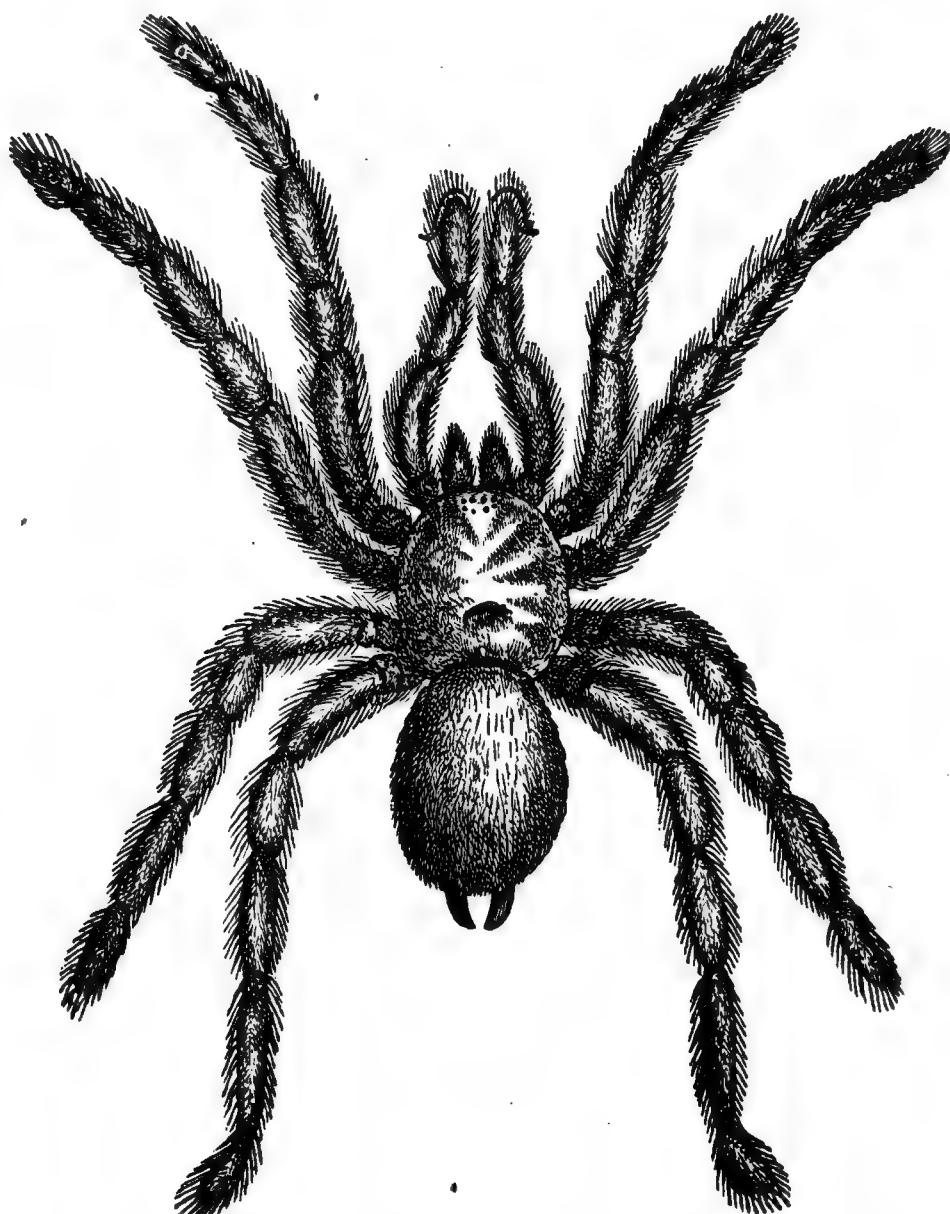
Tarantula Killer.

depth of five inches. There are hundreds of other species of wasps thus solely dependent on the adroit use of their stings for the means of providing for their offspring.

The poison of the spider, which is seldom fatal to man, is lodged in a little gland or sac situated in the head-thorax, and which opens into the jaws, which are hollow, perforated at the end so as to allow the poison to flow into the wound made by the mandible. But very few spiders are poisonous

to man. Hentz, our best American authority, after twenty years of study declared that spiders were not poisonous to man. Blackwall, the English authority, says that none in England are poisonous, as he allowed them to bite him on

FIG. 62.

Trap door Spider, *Mygale*.

different parts of his person without any harm resulting. Occasionally we see deaths reported from the bite of spiders. A late number of "Nature" contains a notice of the Katipo, or venomous spider of New Zealand. Its bite is "occa-

sionally fatal and certainly very painful and distressing." This spider belongs to the genus *Latrodectus*, and Walckenaër, says the same journal, writing of the *Latrodectus malmignatus*, an allied species common in Sardinia and Corsica and parts of Italy, remarks :— "This spider is certainly poisonous ; its bite, they say, causes in man pain, lethargy and sometimes fever." A species of the same genus which lives in Georgia is said by Hentz (and not Abbot as "Nature" says) to have an "undoubtedly venomous" bite.

As regards the bite and habits of the scorpion, the testimony of Anderssen, the African traveller, may be cited as the common experience of inhabitants in the tropics. He says "The instant the scorpion feels himself in contact with any part of the body of a man or beast, he lifts his tail, and, with his horny sting, inflicts a wound which, though rarely fatal, is still of a painful nature. Like the snake, the scorpion is fond of warmth ; and it is not uncommon, on awakening in the morning, to find one or two of these horrid creatures snugly ensconced in the folds of the blanket, or under the pillow. On one occasion I killed a scorpion, measuring nearly seven and a half inches in length, that had thus unceremoniously introduced itself into my bed."

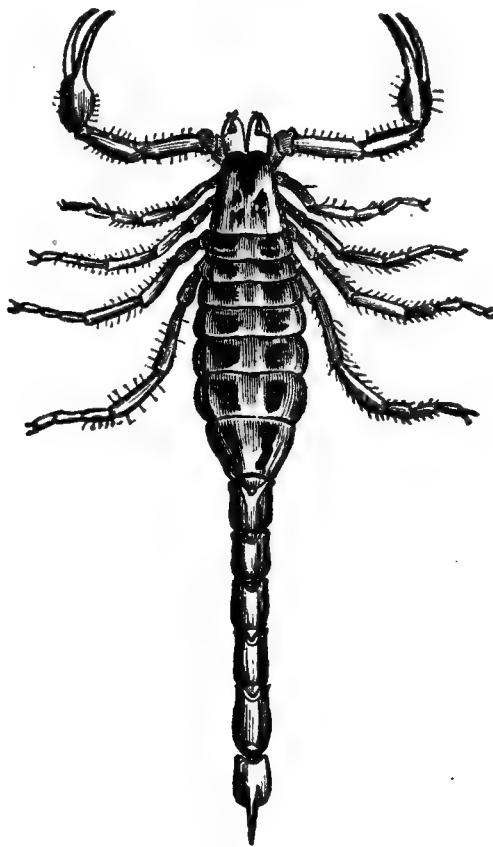
The poison gland of the scorpion, as everybody knows, is lodged in the tail. The scorpion is a timid creature and only uses its sting when alarmed.

Dr. Lincecum has published in the "American Naturalist" an interesting account of the scorpion of Texas, a figure of which we reproduce (Fig. 63). He says that it dwells under old logs, rocks, in old stumps, under the bark of dead trees, under old fences, between the shingles on house-tops and particularly about the jambs and hearths of fire-places. "In temper they are hasty and will employ their weapons on slight occasions. The pain caused by their venom, when injected into one's flesh, is very quickly felt and quite severe, giving the idea of a burning-hot fluid thrown into the system. It

does not last long, nor does it swell much, and is not so painful, nor does it produce so much inconvenience as the sting of the honey bee. In countries where they abound, people do not regard them with much terror. Chickens are very fond of them and voraciously devour every one they can find." The scorpion brings forth its young alive.

The centipede is an annoying and even dangerous insect; the poison glands are lodged in the head, opening into the

FIG. 63.



American Scorpion.

channelled jaws as in the spiders. The bite of the larger species is most formidable.

Few are aware how painful and annoying is the irritation set up by the hairs of certain caterpillars. The hairs of many kinds are finely barbed; such are those of the Ctenucha figured in our frontispiece. The caterpillar feeds on grass, and I extract from my notes an account of the mode in which it constructs its cocoon, tearing its slender barbed

hairs from its body and dextrously weaving them into a firm texture without the aid of silken threads, the hairs being held firmly in place by the barbs.

"June 13th, the Ctenucha larva began to construct its cocoon. Early in the morning it described an ellipse, upon the side of the glass vessel, of hairs plucked from just behind the head. From this elliptical line as a base, it had by eight o'clock built up rather unequally the wall of its cocoon, in some places a third of the distance up, by simply piling upon each other the spinulated hairs, which adhered firmly together. At four o'clock in the afternoon, the arch was completed and the larva walled in by a light thin partition. Soon afterwards the thin floor was made. No silk is spun throughout the whole operation. I afterwards carefully examined portions of the cocoon under the microscope and could detect no threads of any kind."

From this it will appear that aside from their defensive nature, these barbed hairs come into play when the insect prepares to lay aside its caterpillar skin like an old garment, and go into retirement as a chrysalis. So also the hairs of the "woolly bear" caterpillar (*Arctia isabella*) and of the common Vanessa butterfly (*Vanessa Antiopa*) are poisonous to children.

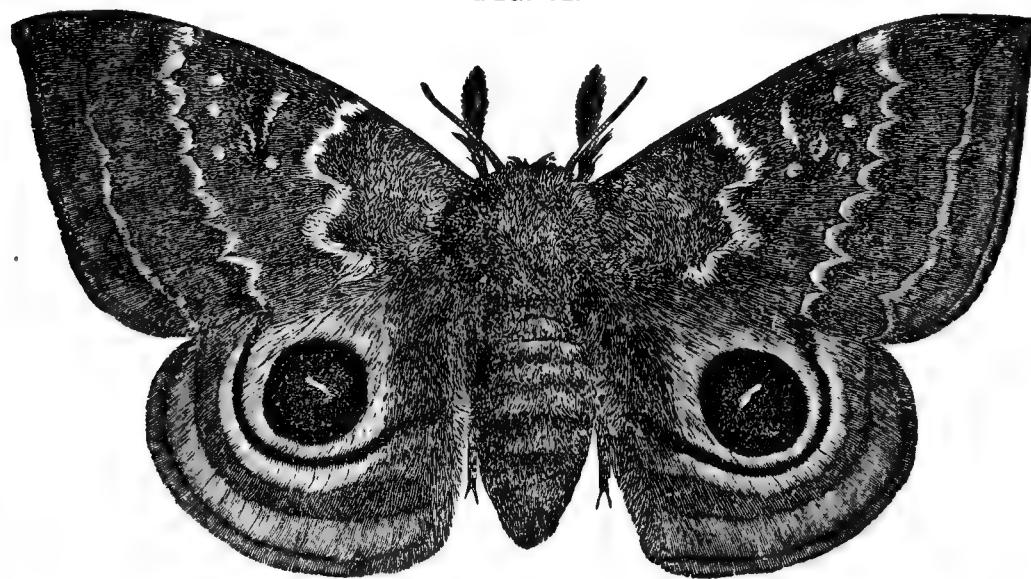
The caterpillar of another moth, the *Empretia stimulea*, is said by Dr. Clemens to be very annoying. "The spines with which the horns are supplied produce an exceedingly painful sensation when they come in contact with the back of the hand or any portion of the body in which the skin is thin."

The caterpillar of the Io moth (*Hypercheiria Io*, Fig. 64; 65 a, b, c, spines), which feeds commonly on corn in the southern states, though in New England it feeds on the maple, is covered with stinging hairs, which are often painful when detached.

The caterpillar of the Maia moth (*Hemileuca Maia*, Fig. 66 a, caterpillar) is armed with still more annoying spines.

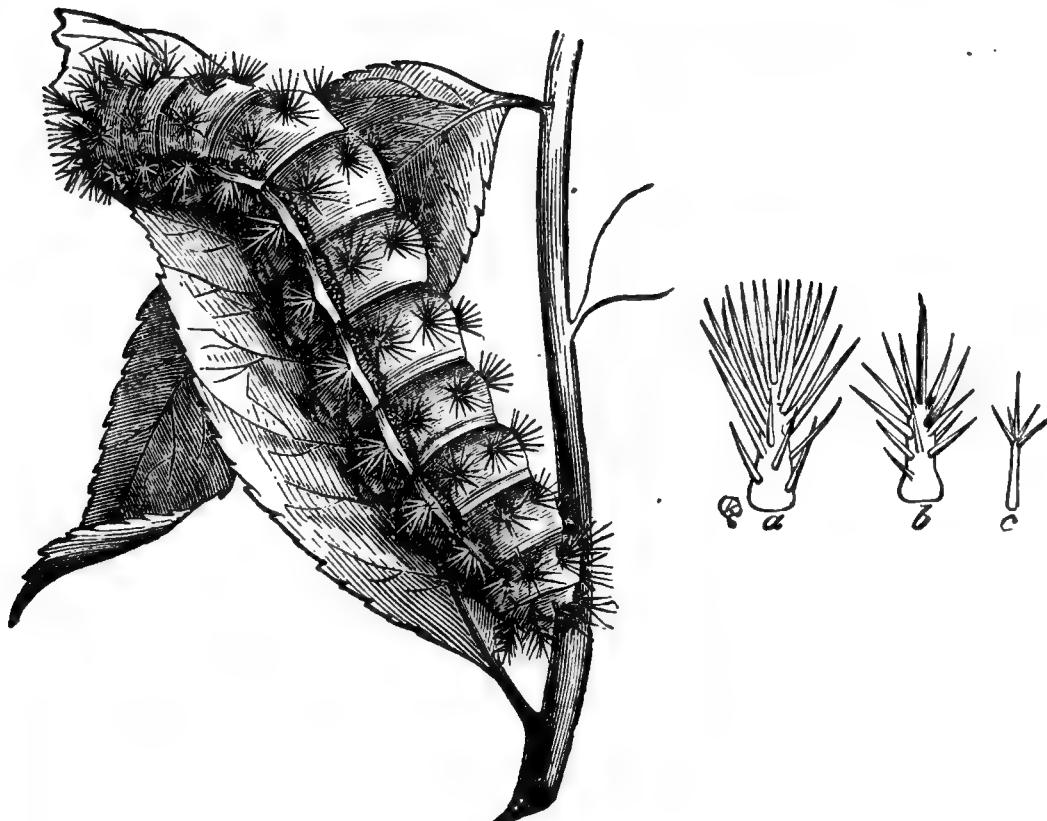
We are indebted to Mr. J. A. Lintner for an excellent account of certain experiments with this caterpillar, which

FIG. 64.



Io Moth.

FIG. 65.

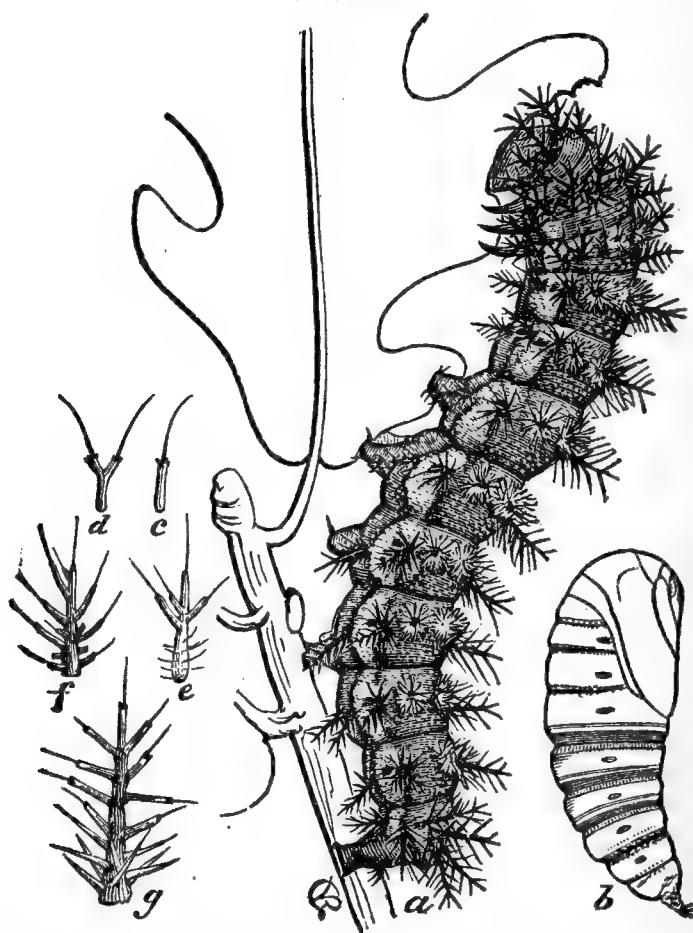


Caterpillar of Io Moth, after Riley.

we copy from his paper in the "Report of the New York State Cabinet for 1869." He remarks that "a larva was

dropped three or four times, from a height of about ten inches, upon the back of the first joint of the thumb. The sensation did not differ materially in kind from the sting of the nettle, but was more acute. In a few minutes the surface became reddened, and in a short time numerous slightly elevated whitish blotches made their appearance, accompanied with a burning and itching. The following day the thumb could not be bent without experiencing a sensible

FIG. 66.



Caterpillar and Pupa of Maia Moth, after Riley.

degree of pain, which was materially increased by an attempt to bring the joint to a right angle. This stiffness of the joint continued for four days. When the blotches subsided, small purplish spots of coagulated blood appeared in their place, which by degrees became more circumscribed, until after the lapse of a few days, when they presented an appearance similar to that of grains of gunpowder burned beneath

the skin. These gradually disappeared; those nearer the surface by a scaling of the skin above them; those deeper, removed by the slower process of absorption, were visible at least two weeks. When the larva was permitted to fall upon the thicker skin of the palm of the hand, a slight stinging sensation was experienced and minute purple dots were developed, continuing a shorter time than the above.

"The sting is doubtless the result, not of broken tips of the spines remaining in the flesh—for none such could be observed by careful scrutiny with a lens—but of a poison secreted by the larva*, and probably injected through a minute aperture in the tip of the spine. Whether its excretion is voluntary or involuntary was not determined, it not having occurred to institute the simple experiment by which that point could readily have been ascertained. A slight motion of the larva, apparently a contractile one, was frequently observed to accompany the sting; but this may have been either defensive, or simply the consequence of alarm at being rudely touched.

"Some tips of the spines clipped off and placed between slides under a high magnifying power, showed, under varying pressure, a motion of fluid within them; but no apical opening could be discovered for its escape.

"The ability to inflict a sting does not belong to all the spines of the larva, but only to those of the two subdorsal rows on segments three to ten, and the dorsal spine on segment eleven. These differ from those elsewhere on the body in their fascicular arrangement, their lesser length, the regular taper of the branches, and their tawny color, as appears in detail in the description given of the mature larva. With this interesting structural peculiarity in mind, the larva may be handled with impunity, as was repeatedly done with the fifty or more individuals composing the colony from which these notes were drawn, in the frequent transfers, which they

*That a poison is secreted seems to us improbable.—A. S. P.

required as they approached maturity, to fresh food and cleansed quarters. With proper care, the thumb and fingers could safely be passed along their sides and beneath them, slowly raising them from the leaf or stem to which they were attached; but if attempted too hastily the larva throws itself in a circle, projects its defensive armor, and inflicts a sting which effectually releases it from the grasp."

Now while nature has protected these caterpillars from their insect enemies, though certain ichneumon flies prey upon them, they seem, whether by reason of their spiny hairs or stiff bristles or other cause, to be distasteful to birds. We are not aware how different are the tastes of birds for different food; as with us so with birds—*de gustibus non disputandum*. We observe how different and arbitrary are the tastes of the dog or horse or cat; so wild animals, including birds, have their individual preferences and dislikes for certain kinds of food. Certain it is that there are many kinds of caterpillars which birds will not eat. The false caterpillar of the cherry sawfly (*Selandria cerasi*) is said by Professor Winchell to be never eaten by birds. The currant sawfly worm, now so destructive in our gardens, is not eaten by birds. In my "First Annual Report on the Injurious and Beneficial Insects of Massachusetts, 1871," occur the following remarks on this point. "As this is an important and practical subject, let us digress for a moment, to notice some facts brought out by Mr. J. J. Weir, of the London Entomological Society, on the insects that seem distasteful to birds. He finds, by caging up birds whose food is of a mixed character (purely insect-eating birds could not be kept alive in confinement), that all hairy caterpillars were uniformly uneaten; such caterpillars are the "yellow bears" (*Arctia* and *Spilosoma*), the salt-marsh caterpillars (*Leucarctia acraea*) and the caterpillar of the vaporer moth (*Orgyia*) and the spring larvæ of butterflies; with these may perhaps be classed the European currant saw-fly. He

was disposed to consider that the "flavor of all these caterpillars is nauseous, and not that the mechanical troublesomeness of the hairs prevents their being eaten. Larvæ which spin webs and are gregarious are eaten by birds, but not with avidity; they appear very much to dislike the web sticking to their beaks, and those completely concealed in the web are left unmolested. When certain branches covered with the web of *Hyponomeuta evonymella* (a little moth of the Tinea family) were introduced into the aviary, those larvæ only which ventured beyond the protection of the web were eaten."

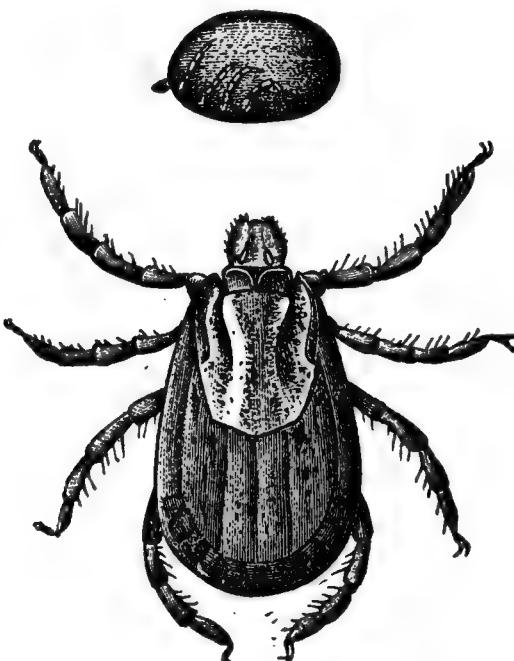
"Smooth-skinned, gayly-colored caterpillars (such as the currant Abraxas or span worm, Fig. 39), which never conceal themselves, but on the contrary appear to court observation" were not touched by the birds. He states, on the other hand, that "all caterpillars whose habits are nocturnal and are dull-colored, with fleshy bodies and smooth skins, are eaten with the greatest avidity. Every species of green caterpillar is also much relished. All Geometræ, whose larvæ resemble twigs, as they stand out from the plant on their anal prolegs, are invariably eaten." Mr. A. G. Butler of London has also found that frogs and spiders will not eat the same larvæ rejected by birds, the frogs having an especial aversion to the currant span worms (*Abraxas* and *Halia*)."

Before leaving the subject of poisonous insects we may refer to those which are indirectly so. Professor Leidy has, as we find in the "American Naturalist" (vol. vi, p. 694), entertained the opinion that flies are probably a means of communicating contagious disease to a greater degree than was generally suspected. "From what he observed in one of the large military hospitals, in which hospital gangrene had existed during the late rebellion, he thought flies should be carefully excluded from wounds. Recently he noticed some flies greedily sipping the diffluent matter of some fungi of the *Phallus impudicus*. He caught

several and found that on holding them by the wings they would exude two or three drops of liquid from the proboscis, which, examined by the microscope, were found to swarm with the spores of the fungus. The stomach was likewise filled with the same liquid, swarming with spores."

Among other insects which frequently annoy travellers in the southern states and in the tropics are the ticks (Fig. 67). It is the habit of these beings to climb up bushes and stalks of grass and attach themselves by means of their outstretched legs to whatever animal passes by, whether a

FIG. 67.



Cattle Tick, enlarged.

beast or lizard or snake, as they occur on all creeping animals. Having attached themselves by their jaws to the skin, they burrow beneath it, causing a painful tumor. It is difficult to pull them out as they are anchored in the flesh by their many-barbed tongue.

We turn again to Anderssen's narrative for an account of the plague this tick may be to the wanderer in Africa.

"Besides myriads of fleas, our encampment swarmed with a species of bush-tick, whose bite was so severe and irritating, as almost to drive us mad. To escape, if possible, the

horrible persecutions of these blood-thirsty creatures, I took refuge one night in the cart, and was congratulating myself on having at last secured a place free from their attacks. But I was mistaken; I had not been long asleep before I was awakened by a disagreeable irritation over my whole body, which shortly became intolerable: and notwithstanding the night air was very sharp and the dew heavy, I cast off all my clothes and rolled on the icy-cold sand, till the blood flowed freely from every pore. Strange as it may appear, I found this expedient serviceable.

"On another occasion, a bush-tick, but of a still more poisonous species, attached itself to one of my feet; and, though a stinging sensation was produced, I never thought of examining the part, till one day, when enjoying the unusual luxury of a cold bath, I accidentally discovered the intruder deeply buried in the flesh, and it was only with very great pain that I succeeded in extracting it, or rather its body, for the head remained in the wound. The poisonous effect of its bite was so acrimonious as to cause partial lameness for the three following months. The bush-tick does not confine its attacks to men only, for it attaches itself with even greater pertinacity to the inferior animals. Many a poor dog have I seen killed by its relentless persecutions; and even the sturdy ox has been known to succumb under the poisonous influence of these insects." Sometimes also while one bivouacs on the ground, these ticks will enter the ear and become exceedingly troublesome. These and other insect intruders can be made to leave their retreats by pouring a drop of oil into the ear.

Fig. 67 gives an excellent idea of the common cattle tick of the south when gorged with blood. The lower figure represents the tick when younger and after fasting. (The upper figure is of the natural size, the lower several times enlarged.) Fig. 68, adult, and six-legged young. Fig. 69 shows the mouth parts much enlarged, with the spiny tongue.

Ticks are gigantic mites. The smaller mites are in some rare cases found even in the veins and arteries of various birds. Among the mites belong the itch mite, and an allied

FIG. 68.

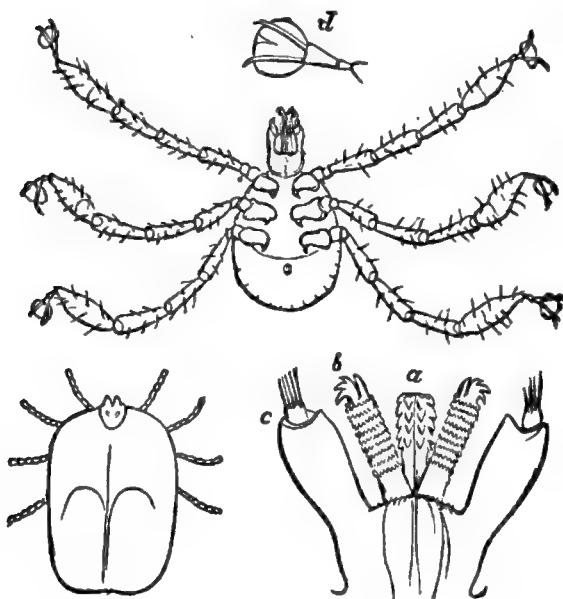
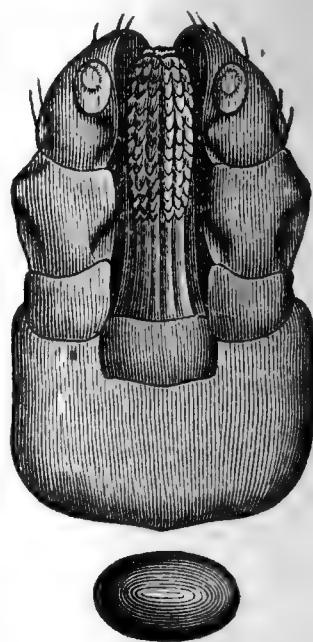


FIG. 69.



Tick, and six-legged young.

form, the *Acaropsis Mericouri*, was found in the pimples on the skin of a French officer who had been in Havana, Cuba, and was afflicted with an exanthematous eruption. M. Tan-

FIG. 70. don, who figures the mite, thinks that it is a kind peculiar to this exanthema. We have seen a similar, though probably different mite taken from the nose of a person in New Orleans. We might before leaving this subject draw attention to the accompanying figure of a long slender mite (Fig. 70, *Demodex folliculorum*) sometimes found in the follicles of the face.

But there is a brighter side to the picture. Insects are not all leagued together to destroy our comfort and rob our pockets. There is the honey bee, one of our domestic animals; if well treated, patient and kind, ceaselessly at work for our benefit. Her life is a constant lesson of thrift and industry. Thanks to Messrs.

Demodex.

Langstroth, Quimby, and Wagner, bee culture has become with us one of the fine arts in agriculture, and a few hives are necessary adjuncts to a well conducted farm. The production of honey and wax has enormously increased in this country, and it is to be hoped that out of the thousands who keep bees, one or two at least may arise who, like Huber, Siebold, Leuckart, Dzierzon and Berlepsch in the old world, may advance our knowledge of the economy of the bee and its modes of reproduction, so intricate and wonderful, and thus lay still broader and deeper the foundations of scientific bee culture. We need not here speak at length on a subject so familiar to many as the structure and habits of the honey bee, and of the various other kinds of bees which store up honey. One point, however, and an important one, has quite recently been cleared up by a German naturalist, Professor Claus. The production of wax is a most important part of bee culture, especially in Catholic countries, where so many candles are used in churches. It is well known that the secretion of wax is carried on during the time when the workers are engaged in building their combs. We are all familiar, at least through pictures, with the festoons of bees hanging from the top of their hives. During this time of repose the secretion of the little disks of wax goes on. How is the wax secreted? The best authorities have differed on this important point. On the one hand Milne-Edwards, the distinguished French naturalist, supposed that the wax-secreting apparatus consisted of special glands, while an equally eminent German, Von Siebold, thought that no such glands existed. A countryman of Von Siebold, however, Prof. Claus, has, from special investigations of his own, confirmed Milne-Edwards' suppositions. I quote from a translation of a part of Claus' article in the "Guide to the Study of Insects." "The wax-secreting apparatus consists of special dermal glands as Milne-Edwards supposed. Claus has shown (see Gegenbaur's *Vergleichenden Anatomie*) that

these minute glands are mostly unicellular, the external opening being through a fine chitinous tube on the outer surface of the integument. In the wax-producing insects, the glands are developed in great numbers over certain portions of the body. In the Aphides, whose bodies are covered with a powder consisting of fine waxy threads, these glands are collected in groups. Modifications of them appear in the Coccidæ. In the wax-producing Hymenoptera the apparatus is somewhat complicated. The bees secrete wax in thin, transparent, membranous plates on the under side of the abdominal segments. Polygonal areas are formed by the openings of an extraordinarily large number of fine pore canals, in which, surrounded by very numerous tracheal branches, the cylindrical gland cells are densely piled upon each other. These form the wax organs, over which a fatty layer spreads. In those bees which do not produce wax, the glands of the wax organs are slightly developed. Wax organs also occur in the humble bees." I find in the "Academy" for Feb. 13, 1873, that Dr. Von Schneider is of the opinion that wax (which he thinks is undoubtedly a secretion of the honey bee) "is formed chiefly at the expense of different kinds of sugar; but he considers that the production of wax from sugar cannot be maintained without simultaneous access to food containing nitrogen."

As regards the mode of production of honey, which we are much in the dark about, as we have heretofore only known that it is elaborated by some unknown chemical process from the food contained in the crop, and which is regurgitated into the honey cells, Von Siebold throws more light upon it by his able anatomical researches, aided by the chemist, Von Schneider. From the "Academy" we learn that "at the annual agricultural meeting, held in October, 1871, at Munich, a well known apiarian, Herr Mehring, exhibited a peculiar kind of honey that he named 'Kunst-Honig' (artificial honey), and which he had pro-

duced by feeding his bees exclusively with malt. This honey excited great interest, and the question was raised whether this substance was real honey, and whether, consequently, the bee was able to change malt-sugar in its stomach into honey. . . . Dr. Von Schneider arrived at the conclusion that the carbo-hydrates, sucrose and dextrose, contained in the malt are actually changed by the bee into honey sugar, and that Mehring's honey only differs from other honeys in the absence of the specific aroma which is imparted to them by the flowers from which the bees have been gathering. Now," adds the "Academy," in quoting the account from the "Bienen Zeitung" "after the fact had been established that honey and wax are not substances found as such by the bee, but are productions which have undergone chemical change through contact with the secretions of the insect, Prof. Von Siebold directed his attention to the investigation of the secreting organs, a branch of anatomy which indeed had not been entirely neglected, but which is now treated for the first time with regard to the special functions those organs appear to perform in the preparation of the products of the bee. Prof. Von Siebold distinguishes three entirely distinct and very complicated systems of salivary glands, two of which (a lower and upper) are situated in the head, and the third in the anterior part of the thorax, the latter having been erroneously regarded by Fischer as a lung. Each of them has separate excretory ducts, and is distinguished by a specifically different form and organization of the vesicles secreting the saliva. Each consists of a right and left glandular mass, with right and left excretory ducts. For the detailed account of their minute structure we must refer to the paper itself, and the plate accompanying it. It may however be mentioned that this extraordinary development of the salivary organs has been observed by Prof. Von Siebold in the workers only. The queen possesses only a rudiment of the lower cephalic system in the form of the

two orifices of the ducts, while the ducts themselves as well as the glands are absent, and the two other systems are much less developed than in the workers. In the drones not even the orifices of the lower cephalic system could be found."

We may now consider the other wax-producing insects whose products, at first found in such minute quantities, go to swell the wealth of nations, as in Great Britain alone about \$1,000,000 worth of wax is used. While there is true vegetable wax formed on the berries of our Candlemas bush or Bayberry (*Myrica*) yet the *pela* wax of China is secreted by a certain kind of *Coccus*, or bark-louse. Westwood in his "Modern Classification of Insects" (vol. ii, p. 449) tells us that the *Coccus ceriferus* Fabr., described by Anderson in his letters from Madras (1781), and by Pearson in the "London Philosophical Transactions," 1794, is employed in the production of a white wax, the body of the female being enveloped in a thick and solid coat of it. We have with us certain kinds of bark lice which secrete a woolly mass which envelopes their body. Such is the mealy bug found upon our house plants, and to which we shall again refer in subsequent pages.

We have glanced at some of the relations of insects to ourselves, and if some memories not altogether of an agreeable nature have been awakened, yet upon the whole it will be felt that these little beings serve some good purpose in the world, and minister in many ways to our personal comfort.

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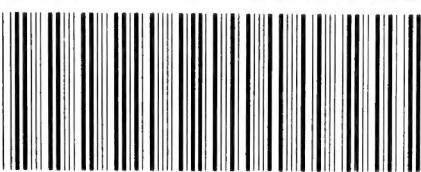
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